**High Level Design**

**Context:**

**Objective:** This system streamlines the traffic management system for the city traffic management authorities, and allows the traffic lights for both vehicles and pedestrians to trigger dynamically to provide smoother flow.

**Background:** As the number of vehicular and pedestrian traffic increases in urban and   
suburban centres all over the world, it gets much more difficult for the existing city infrastructure to keep up. Statically timed traffic lights often slow down traffic, especially if there’s heavy flow. Moreover, due to congestions, emergency vehicles are often delayed in reaching the emergency locations.

**Design:**

**Overview:** This system is designed to identify, monitor and track vehicle and pedestrian movement patterns in real-time using computer vision and edge devices, and cloud devices for further analysis and control. Cloud and edge devices can freely communicate with each other to manage traffic in real-time on a micro as well as macro basis. Storage is chosen such that reads/writes are performed in real time.

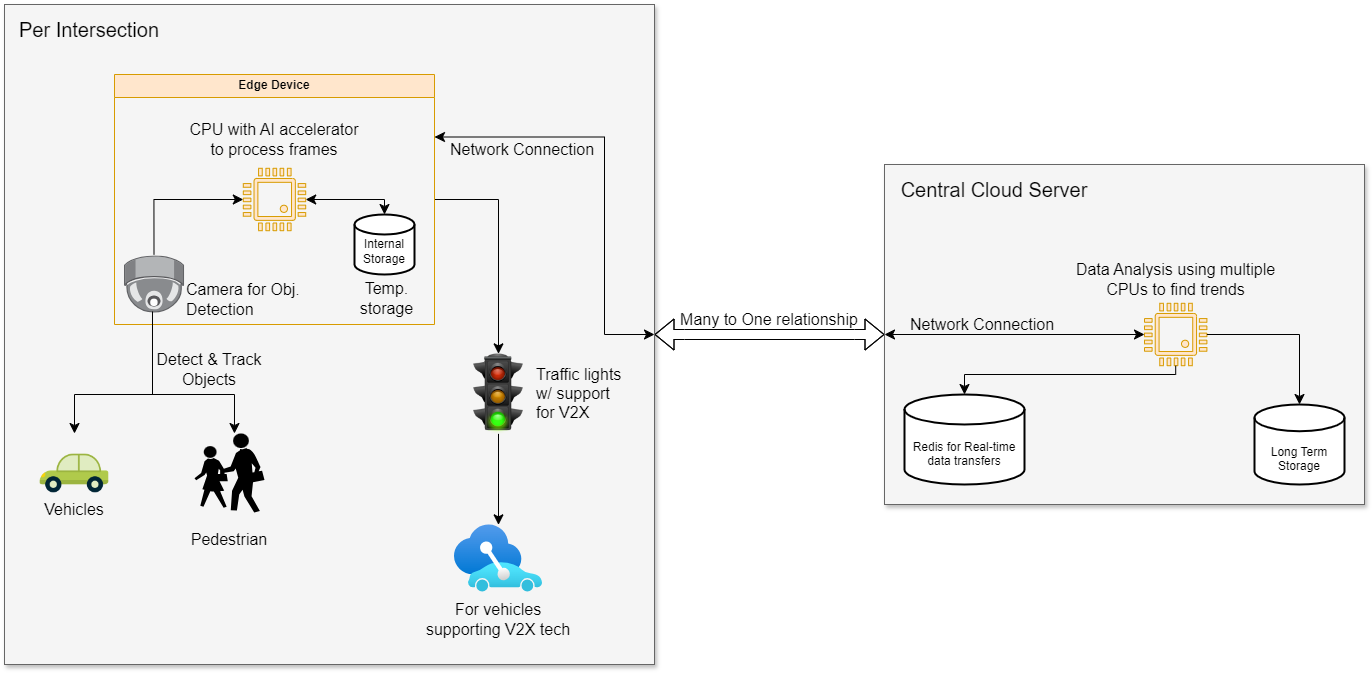
**Functional Requirements:**

* Object Detection
  + Detect vehicles and pedestrians in real-time from a live video stream on edge node.
  + Classify the object using a pre-trained or a custom trained model.
* Object Tracking
  + Continuous tracking while in frame achieved by ByteTrack.
  + Assign unique IDs to objects in frame for counting.
* Count Analysis:
  + Counting objects passing through pre-defined zones.
  + Plot a time-distribution graph based on frequency of traffic. Further analyse these trends over a week to find trends in traffic.
* Data Management:
  + Tracking data and IDs of vehicles passing by at specific times are recorded and stored in a centralized DB.
  + Ensure consistency of data across multiple locations.
* Cloud and Edge Computing:
  + Video streams and on-spot decisions for traffic lights are taken by edge devices to reduce latency.
  + For storage and analysis on a large-scale basis, cloud services are used.

**Capacity Estimates:**

1. Active vehicles per day – 2,00,000+
2. Number of edge devices in an urban city – 5000
3. Short-term storage per edge node – 8GB
4. Total storage for all node devices – 8 \* 5000 = 40,000 GB
5. Data size per vehicle that passes – 22 bytes
6. Data transferred to cloud from edge nodes, only vehicle records – 22 B \* 30 Vehicles/min \* 60 minutes = 39 KB
7. Data received by Cloud for 5000 Nodes per Hour – 189 MB
8. Data received by Cloud for 5000 Nodes per Day – 4.5 GB
9. Long term storage over 5 years for traffic data – 4.5 GB per day \* 365 days/year \* 5 years = 8212.5 GB = 8 TB

**Detailed Design:**

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